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LAND SNAILS OF THE GENUS AMPHIDROMUS FROM THAILAND (MOLLUSCA: PULMONATA: CAMAENIDAE)

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LAND SNAILS OF THE GENUS AMPHIDROMUS FROM THAILAND (MOLLUSCA: PULMONATA: CAMAENIDAE)

By Alan Solem [1]

Introduction

Among the many zoological collections made in Thailand by the late Hugh M. Smith in the 1920's and 1930's were 91 sets of *Amphidromus* containing almost 500 specimens. This is by far the largest and most varied collection known from Thailand and greatly increases our knowledge of the distribution and variation of Thailand species. Through the courtesy of Dr. Harald A. Rehder, Division of Mollusks, U.S. National Museum, it was possible to prepare this report on Smith's collections. Unless otherwise indicated, all material discussed below was collected by Hugh M. Smith and is deposited in the U.S. National Museum (USNM). Notes are included on some additional material in the Academy of Natural Sciences of Philadelphia (ANSP), and a few duplicates from Smith's sets are deposited in Chicago Natural History Museum (CNHM).

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An annotated catalogue of *Amphidromus* (Laidlaw and Solem, 1961) was completed before this study was undertaken, and, for the sake of brevity, literature references are restricted to the original citations and the discussion in the recent catalog.

The laborious calculation of standard deviations was performed by Mr. Ernest J. Roscoe.

CITED LOCALITIES.—Variant spellings of Thailand city and place names are numerous, requiring great care in designating localities. Fortunately, a gazeteer of Smith's collecting stations and a condensed itinerary of his travels has been given by Riley (1938). All the localities mentioned below can be located through use of this paper.

DISTRIBUTION IN THAILAND.—Nine species were recognized in the available material. Accepting the zoogeographic division into Southeast, East, Central, North, West, and Peninsular Thailand (Riley, 1938), the most species are found in Peninsular and Southeast Thailand, seven and six respectively; the fewest in West and North Thailand, one and two respectively. The larger, "typical" *Amphidromus*—*A. inversus annamiticus* and *A. atricallosus*—are concentrated in Southeast and Peninsular Thailand although *A. atricallosus* extends into the nearby fringes of Central, West, and East Thailand. *A. areolatus, A. semitessellatus,* and *A. schomburgki* (to a lesser extent) also show the Peninsular and Southeast Thailand distribution. There are single records for *A. areolatus* in both Central and East Thailand, while *A. schomburgki* is apparently common in East Thailand. *A. xiengensis* is known from North, Central, and Southeast Thailand, *A. sinensis indistinctus* from North and (?) Peninsular Thailand, and *A. fultoni* from a single juvenile collected in Peninsular Thailand. These data are insufficient to allow other than the most general statements. Obviously the number of species drops off sharply from South to North, and the northern part of Thailand represents the fringes of distribution for *Amphidromus*. In Burma, Pakistan, and part of India, some *Amphidromus* are known from more northerly latitudes than in Thailand, but the distributional picture in Laos, North Viet Nam, and possibly Southern China is uncertain.

REVIEW OF SPECIES.—Laidlaw and Solem (1961) recognized 20 species groups in *Amphidromus*, divided into the subgenera *Syndromus*, *Goniodromus*, and *Amphidromus* sensu stricto, and a "base stock" series of six groups from mainland Southeast Asia that could not be assigned to subgenera with any degree of assurance. They hypothesized that *Syndromus*, *Goniodromus*, and *Amphidromus* represented directions of differentiation that were well marked on Indonesian islands but had not become clearly recognizable on the mainland. Study of the Thailand material confirmed this impression of close affinities among the mainland species, particularly in regard to

A. xiengensis, *A. areolatus*, and *A. semitessellatus*. Typical examples were immediately separable, but several sets were examined that were exceedingly difficult to allocate. What I have called *A. areolatus* is relatively small (23–28 mm. high) with a closed to moderately open umbilicus, thin shell, usually a reddish columellar patch, and brown and yellow spiral zones on the base of the shell. *A. semitessellatus* is a larger (28–39.5 mm. high), much thicker and heavier shell, with the columella nearly straight, and the basal portion of the aperture sharply rounded or actually angulated, the umbilicus closed or a narrow chink, with purple, yellow, or no subsutural bands, and only medial interruption of the radial streaks (when present). *A. xiengensis* is usually a large (30-39 mm. high) shell with a red subsutural line, narrowly to widely open umbilicus, columella curved and basal margin of aperture broadly rounded; the radial streaks (when present) interrupted by one to several spiral zones. Shells from Kao Sabab, tentatively referred to *A. xiengensis*, are smaller (27.5–34.3 mm. high), lack the red subsutural band, have a more sharply rounded basal margin of the aperture, but show the *xiengensis* color pattern. Another set from Kao Pae Nam have the size, subsutural line, and radial streaks of *A. xiengensis*, but the columellar patch and aperture of *A. areolatus*. It is tentatively grouped with *A. xiengensis*.

While sets of *A. xiengensis*, *A. semitessellatus*, and *A. areolatus* are usually readily separable, single specimens or short series of worn shells are difficult to identify. As indicated below, each species has a typical color pattern, but individual variations with almost complete loss of color pattern occur in each species. The demonstrated occurrence of dwarf ecotypes in *Amphidromus* prevents size criteria from being utilized as a distinguishing feature. Probably a combination of ecological, anatomical and conchological studies will be necessary before the relationship of the various forms can be accurately determined.

The Thailand shells are listed in the same sequence used by Laidlaw and Solem (1961).

Amphidromus sinensis var. *indistinctus* Pilsbry, 1900

PLATE 1 (FIG. 10)

Amphidromus sinensis var. *indistinctus* Pilsbry, 1900, Man. Conch., ser. 2, vol. 13, p. 192, pl. 62, fig. 70 [mountains of Laos].—Laidlaw and Solem, 1961, Fieldiana, Zool., vol. 41, no. 4, p. 523.

Two adult shells from Ban Nam Kien (USNM 405863) and Ampur Chiengdao (USNM 420332), North Thailand, are unquestionably this form. They are, respectively, 35.7 and 35.1 mm. high, h/d

ratios 1.96 and 1.94, with 7 and 6½ whorls. A third shell from Kao Chong, Patalung(?) (USNM 419829), is 28.6 mm. high, h/d ratio 1.91, with 6½ whorls. It is slightly thinner than the other two and the surface is relatively worn. Possibly it is misidentified.

Amphidromus glaucolarynx (Dohrn, 1861)

PLATE 2 (FIG. 1)

Bulimus glaucolarynx Dohrn, 1861, Proc. Zool. Soc. London, 1861, p. 207, pl. 26, fig. 7 [Siam].

Amphidromus glaucolarynx (Dohrn).—Laidlaw and Solem, 1961, Fieldiana, Zool., vol. 41, no. 4, pp. 524–525.

Specimens of the relatively obese *A. g.* f. *fasciatus* von Martens were seen from Wang Kien (USNM 427382), Srakeo (USNM 419794), and Petchaburi (USNM 365544) in Central Thailand plus Pak Chong (USNM 367511) in East Thailand. Three of the four adults are sinistral, the fourth dextral. Height ranges from 32.7–38.2 mm., h/d ratio 1.63–1.84, whorls 6 to 6⅞.

Amphidromus schomburgki (Pfeiffer, 1860)

Bulimus schomburgki Pfeiffer, 1860, Proc. Zool. Soc. London, 1860, p. 137, pl. 51, fig. 9 [Siam].

Amphidromus schomburgki (Pfeiffer).—Laidlaw and Solem, 1961, Fieldiana, Zool., vol. 41, no. 4, p. 526.

Material from Sriracha (USNM 405883a), Hinlap (USNM 420314), and Kao Sabab at 1,000 feet elevation (USNM 427328) in Southeast Thailand; Lam Tong Lang near Pak Chong (USNM 365461, USNM 427374), Pak Chong (USNM 365462, USNM 365540, USNM 405907, USNM 405910), Chantuk near Pak Chong (USNM 427370), Lat Bua Kao near Pak Chong (USNM 419883), and Aranya Predesha (USNM 405862) in East Thailand; and Pran (USNM 419800), Peninsular Thailand, represents mostly the *moellendorffi* color phase, with purple tip and green deciduous periderm. A few specimens have the stripes yellow brown rather than green and one shell (USNM 405907) has the purple spiral bands on the first five whorls, thus approaching the typical color phase. Two shells (USNM 365540 from Pak Chong) and one of three from Chantuk (USNM 427370) have white—not purple—lips, calluses, and spires. The Chantuk shell has a purple tip. The specimens from Sriracha show the same dwarfing, when compared with Pak Chong examples, that are found in the forms of *A. atricallosus* from the Sriracha area. Variation in size and shape is summarized in table 1.

TABLE 1.—*Size variation in* Amphidromus *of Thailand*

(E=East Thailand; SE=Southeast Thailand; P=Peninsular Thailand; N=North Thailand)

Species, locality, USNM nos.	No. of specimens	Height			Diameter			H/D Ratio			Whorls
		Mean	Range	S.D.	Mean	Range	S.D.	Mean	Range	S.D.	Mean
A. schomburgki											
Pak Chong, E (365462)	10	49.0	45.6–56.8	3.30	26.7	24.8–30.0	1.48	1.84	1.75–1.91	.053	7 3/16
Sriracha, SE (405883a)	5	40.4	36.1–42.4	2.48	24.7	23.7–25.9	0.83	1.63	1.52–1.69	.066	6½
Lam Tong Lang, E (427374, 365461)	21	49.3	40.1–55.9	3.83	27.0	23.5–30.1	1.62	1.82	1.69–2.00	.089	7¼
A. inversus annamiticus											
Koh Samet, SE (419153)	13	44.1	39.4–49.3	2.92	24.4	22.5–26.0	1.26	1.81	1.65–1.97	.131	7
Koh Samet, SE (384154)	11	42.2	33.9–47.8	4.41	23.6	22.2–24.5	0.95	1.79	1.53–1.96	.138	6½
Bandon, P (361481)	22	46.0	41.8–50.5	2.56	26.3	24.7–27.7	0.94	1.75	1.68–1.85	.052	7⅜
A. semitessellatus											
Sam Roi Yot, P (420457, 420458)	9	36.0	33.9–39.3	1.72	17.5	16.7–18.4	0.57	2.06	1.93–2.22	.090	6 13/16
A. xiengensis											
Chiengdao, N (419906, 420330, 420333)	21	34.8	31.2–38.5	2.26	17.4	16.4–18.9	0.82	2.00	1.81–2.20	.089	6 1/16
Kao Sabab, SE (427316, 427324, 427336)	7	30.1	27.5–34.3	2.18	15.4	14.7–16.9	0.80	1.95	1.81–2.08	.095	6⅞

Amphidromus atricallosus (Gould, 1843)

PLATE 1 (FIGS. 1–3, 8–9)

Bulimus atricallosus Gould, 1843, Proc. Boston Soc. Nat. Hist., vol. 1, p. 140 [Philippine Islands (error)].

Amphidromus atricallosus (Gould).—Laidlaw and Solem, 1961, Fieldiana, Zool., vol. 41, no. 4, pp. 530–531.

This is a common and variable species in Peninsular and Southeast Thailand. There are a few scattered records from the mountains along the Cambodian border, but otherwise this species is unknown from most of the country. Four distinctive color phases can be recognized. They are:

1. Typical *atricallosus* (pl. 1, fig. 1): parietal callus brown or purplish-black with one or more dark varices on the spire.

2. Form *leucoxanthus* von Martens, 1864 (pl. 1, fig. 8): one or more varices present, but the parietal callus without dark markings.

3. Form *perakensis* Fulton, 1901 (pl. 1, fig. 9): varices and parietal coloration absent, subsutural white zone usually more marked than in the other varieties.

4. Form *laidlawi*, new color form [2] (pl. 1, fig. 3): whitish shell with narrow, rather crowded, pale brown radial streaks that parallel the lines of growth. One or more varices are usually present.

The first three forms were described as full species, and their type figures are markedly different in size, shape, and coloration. *A. atricallosus* was based on the relatively large (50–55 mm. high), elongated, bright yellow shells from Tenasserim, Burma; *A. leucoxanthus* von Martens, on the whiter, more obese, slightly smaller shells subsequently found in Southeast Thailand; and *A. perakensis* Fulton, on the large, elongated, pale yellow shells with a sharply twisted columella that are common in Perak and northern Malaya. The variations in pattern, size, shape, and columellar configuration extend through the range of the species and it does not seem practical, at this time, to delineate subspecific units.

Color and columellar variation in the adult Thailand shells examined is indicated in the list of material by the following abbreviations:

L=*leucoxanthus* coloration
P=*perakensis* coloration with a distinct columellar plait
S=*laidlawi* coloration

[2] Holotype: USNM 363619 from Nong Khor, Southeast Thailand. Great pleasure is taken in naming this beautiful new form after the late Mr. F. F. Laidlaw of Foxearth, Sudbury, Suffolk, England, who is responsible for my interest in *Amphidromus* and who graciously allowed me the privilege of coauthoring his catalog of the genus (Laidlaw and Solem, 1961).

T=*atricallosus* coloration
Lc=simple, untwisted columella
Pc=a twisted columella or columellar plait present.

Thus the notation after a catalog number of "9 L, 3 S+Pc" indicates that the set contained nine shells with *leucoxanthus* coloring and simple columella and three shells with *laidlawi* coloration and a twisted columella. Since most *leucoxanthus*, *atricallosus*, and *laidlawi* variations had simple columellas and most *perakensis* forms had twisted columellas, it was thought necessary to list only the exceptions.

The following sets of Thailand *A. atricallosus* were examined:

Peninsular Thailand.—Ban Huey Ta, west of Nakron Sritamarat: USNM 405659 (juvenile); Chumporn, west side of the Gulf of Siam: USNM 420275 (juvenile); Sichon, southeast of Bandon: USNM 405903 (1 T); USNM 405872 (4 T); Kao Luang, west of Nakron Sritamarat: USNM 419189 (2 T); Kao Chong, east of Trang: USNM 427306 (1 P); Kao Soi Dao, west of Singora and southeast of Trang: USNM 427311 (4 P); Tha Lo, southwest of Bandon: USNM 384157 and USNM 419151 (9 T, 4 T without varices, 3 L, 1 S+Pc, 1 P+Lc).

West Thailand.—Prachuab Kirikhan (=Koh Lak), west side Gulf of Siam: USNM 427292 (5 T).

Central Thailand.—Srakeo, near Krabin: USNM 419793 (1 P).

Eastern Thailand.—Lem Sing, Chantabun: USNM 405864 (1 L, 1 L+Pc), USNM 420286 (1 L); Kao Lem Sing, Sankambeng Range: USNM 384152 (3 L+Pc); Pak Chong (=Pak Jong): USNM 365463 (1 S).

Southeast Thailand.—Nong Yang, east of Sriracha: USNM 384158 and USNM 384158b (3 L, 7 L+Pc, 2 P, 2 S, 1 S+Pc); Nong Khor, near Sriracha: USNM 363617 (juvenile), USNM 363616 and USNM 405861 (19 P, 2 P+Lc, 13 L, 9 L+Pc, 1 T, 1 P+S), USNM 363619 (7 S, 2 S+Pc), USNM 367510 (6 L, 2 L+Pc, 1 P, 1 S); Hoi Yang, near Sriracha: USNM 420288 (3 P, 4 L), USNM 410489 (2 L+Pc), USNM 420290 (1 S); Sriracha, Gulf of Siam: USNM 405883 (worn), USNM 427345 (1 L, 1 L+Pc, 1 S+Pc); Ban Sadet, between Sriracha and Hupbon: USNM 363618 (1 L, 2 L+Pc); Chantabun (=Chantaburi): USNM 427341 (1 P, 1 P+Lc); Kao Sabab, near Chantabun: USNM 427331 (worn, most Pc); USNM 529518 (1 L); Koh Kut, island in Gulf of Siam: USNM 405835 (1 P+Lc); USNM 419788 (1 P); Kao Saming, in coastal plain near Krat: USNM 419184 (juvenile); Krat (=Trad), on Krat River: USNM 405655 (3 L, 4 L+Pc, 3 S+Pc); Kao Bantad, east of Krat near Cambodia: USNM 405858 (6 L+Pc, 1 P, 1 S, 1 S+Pc).

The distribution of the color phases is obviously not uniform. Thus, while two-thirds of the specimens from Peninsular Thailand are of the *atricallosus* phase, only one of the 119 shells from Southeast Thailand has the darkened parietal callus. Similarly, 21 of the 23 known *laidlawi* are from Southeast Thailand. The *leucoxanthus* and *perakensis* color forms seem less restricted in area, and it is certain that simple and twisted columellas occur in many localities. The larger samples from Kao Bantad, Nong Khor, Nong Yang, Krat, and Tha Lo contained a mixture of color forms and, while Southeastern

and Peninsular Thailand probably have different proportionate representation of color forms, there is no evidence that this is indicative of subspecific differentiation.

The specimens of *atricallosus* pattern from Tha Lo had the extent of the parietal coloration noticably reduced and there is one lot of four shells (ANSP 284220, CNHM 109473) from "Khao Luang," a mountain west of Prachuab Kirikhan[3] at 11°40′ on the Burmese-Thailand border that are quite unusually patterned (pl. 1, fig. 2). They have the callus and varix of *atricallosus*, but a reddish-brown color suffusion on the body whorl that is intensified into vague radial streaks and spiral color zones with hint of a peripheral spiral yellow fillet as in the *sultanus* and *interruptus* phases of *A. perversus*. The color pattern of *A. comes* is similar. Specimens from Prachuab Kirikhan have purplish banding on the upper whorls that is similar to that found in *A. janus*. No other color variations require special comment.

Size and shape variation is summarized in table 2. While there are great differences in size and shape between, for example, the Nong Khor and Prachuab Kirikhan populations, this probably reflects local ecological conditions rather than true geographic variation, since the Kao Sabab, Kao Bantad, Krat, and Kao Lem Sing samples from Eastern and Southeastern Thailand are in the size range of the Prachuab Kirikhan population rather than the dwarfed shells from the Sriracha area. Specimens of *Amphidromus schomburgki* from Sriracha are similarly dwarfed when compared with Pak Chong examples (see above), and it is probable that the Sriracha region is a marginal area for *Amphidromus*.

Variation in *A. atricallosus* within Southeast Thailand, for example, is much greater than differences (except in color frequency) observed in comparing specimens from the different zoogeographic areas of Thailand, and there thus seems to be no basis for recognizing subspecies. Possibly collections from the Tenasserim area may result in delineating a moderately restricted geographic range for the *atricallosus* predominance, but, in view of the great color variation, I would hesitate to create subspecies on color pattern frequencies.

Some strikingly colored shells from the Anambas Islands are referred to the *leucoxanthus* pattern. One from Pulo Telaga (USNM 161934) and six adults from Pulo Riabu (USNM 161923) are most similar to the orange shells figured by Pilsbry (1900, pl. 54, figs. 78–79). Possibly these are the "*A. chloris*" reported by Jacobi (1895) from

[3] This locality of de Schauensee should not be confused with the Kao Luang west of Nakon Sritamarat that was visited by Smith. "Khao Luang" is the same as Smith's Kao Luong.

TABLE 2.—*Size variation in* Amphidromus atricallosus

(W=West Thailand; P=Peninsular Thailand; E=East Thailand; SE=Southeast Thailand)

Locality and USNM nos.	No. of specimens	Height			Diameter			HD/ratio			Whorls
		Mean	Range	S.D.	Mean	Range	S.D.	Mean	Range	S.D.	Mean
Prachuab Kirikhan, W (427292)	5	52.4	47.0–56.9	4.12	28.4	25.1–31.2	2.36	1.85	1.79–1.87	.035	7
Kao Soi Dao, P (427311)	4	49.3	47.1–51.3	1.65	25.7	24.4–26.5	1.02	1.93	1.86–20.3	.076	7
Tha Lo, Bandon, P (384157, 419151)	20	44.2	40.1–52.2	2.59	24.4	22.3–26.2	1.01	1.81	1.71–1.99	.076	6¾
Sichon, P (405872)	4	47.5	46.3–49.2	2.39	25.6	24.9–26.6	0.76	1.87	1.85–1.88	.015	6¾
Kao Lem Sing, E (384152)	3	51.3	50.1–53.1	—	26.2	25.4–26.7	—	1.96	1.90–2.09	—	7⅛
Lem Sing E (420286, 405864)	3	45.7	44.6–47.5	—	25.5	25.2–26.0	—	1.79	1.77–1.84	—	6¾
Kao Bantad, SE (405858)	9	48.5	45.4–51.9	1.87	27.5	26.1–28.5	0.78	1.77	1.60–1.91	.087	6¾
Kao Sabab, SE (427331)	20	48.3	45.1–54.4	2.47	26.9	25.0–29.4	1.11	1.79	1.64–1.90	.082	6⅞
Krat, SE (405655)	10	47.1	45.8–50.2	1.44	26.7	25.9–27.6	0.58	1.76	1.67–1.88	.063	6¾
Ban Sadet, SE (363618)	4	44.7	42.4–46.9	2.33	26.0	25.2–26.7	0.67	1.73	1.71–1.77	.041	6¾
Nong Yang, SE (384158, 384158b)	15	42.7	35.4–48.0	3.10	24.8	22.1–26.3	1.37	1.72	1.60–1.87	.067	6 1/16
Hoi Yang, SE (420288)	7	41.5	37.7–44.9	2.69	24.0	22.8–24.5	0.78	1.73	1.66–1.84	.058	6¾
Sriracha, SE (405883)	11	41.5	38.4–44.0	1.90	24.8	22.3–26.1	1.59	1.68	1.58–1.78	.055	6 7/16
Nong Khor, SE (363619)	9	41.0	37.4–44.9	2.06	24.0	21.9–24.9	1.04	1.71	1.62–1.82	.065	6¾
(367510)	10	40.6	36.8–44.2	2.36	23.3	21.9–25.6	1.24	1.75	1.62–1.86	.084	6½
(363616, 405861)	45	39.6	36.0–45.4	1.99	23.6	21.5–26.8	1.24	1.70	1.57–1.82	.057	6⅝

the Anambas Islands. The USNM material was collected by W. L. Abbott in 1899 and 1900. No soft parts are available.

Amphidromus inversus annamiticus (Crosse and Fischer, 1863)

Bulimus annamiticus Crosse and Fischer, 1863, Journ. de Conch., vol. 11, pp. 357–359 [Saigon].

Amphidromus inversus annamiticus (Crosse and Fischer).—Laidlaw and Solem, 1961, Fieldiana, Zool., vol. 41, no. 4, p. 561.

Specimens of this subspecies were seen from Bandon, Peninsular Thailand (USNM 361481), on trees in the town; Koh Sichang (USNM 405866), an island off Sriracha near the head of the Gulf of Siam, Southeast Thailand; and Koh Samet (USNM 384154, USNM 384200, USNM 419153, USNM 419804), an island in the Gulf of Siam, Southeast Thailand. The shells from Bandon are much larger than those from Koh Samet (see table 1), probably reflecting the well-known small island dwarfing effect on land snails. Most specimens have a white background color, but some have the reddish tint of variety *roseotincta* von Moellendorff.

Amphidromus areolatus (Pfeiffer, 1861)

PLATE 1 (FIGS. 4–7)

Bulimus areolatus Pfeiffer, 1861, Proc. Zool. Soc. London, 1861, p. 194 [Siam].

Amphidromus areolatus (Pfeiffer).—Laidlaw and Solem, 1961, Fieldiana, Zool., vol. 41, no. 4, p. 564.

A number of diverse color forms are grouped with some hesitation. Few specimens were available and only one of the color phases was seen from several localities. Possibly some subspecific division may be warranted when more material can be studied. The seven observed color forms are:

1. Three shells from Kao Chong (USNM 427307) in Peninsular Thailand have two purplish red basal bands—the upper much narrower than the lower—that are separated by an intense yellow band margined by narrow white zones. There are slight traces of a reddish columellar patch. The tip is purple and the spire white or pale yellow (pl. 1, fig. 4). This pattern is the same as that of *A. sinensis*, which differs in being a much larger, heavier and usually more globose shell. Both measurable adults from Kao Chong are 24.7 mm. high with 6 whorls.

2. Four shells from Tale Sap (USNM 361448), Peninsular Thailand, have the basal pattern of the above, with the addition of vague streaks and spots on the upper portion of the spire. This is very close to the pattern of *A. sinensis* var. *gracilis* Fulton, 1896 from Pegu, Burma, which may be a form of *A. areolatus*. The *gracilis* of Fulton is stated to have four rows of spots on the upper spire, while the Tale Sap shells have irregular blotches (pl. 1, fig. 5). The three measurable

adults are, respectively, 25.0, 23.2 and 23.0 mm. high; h/d ratio 1.91, 1.86 and 1.77; with 6, 5¾, and 5¾ whorls.

3. Three shells from Nong Khor (USNM 363620), southeast Thailand, have the spotting and streaking intensified and extending onto the body whorl. However, the basal banding is absent in one, the second is the same as in number 2, and the upper band is split into two on the third. There is no trace of a columellar color patch. They are 23.4–26.1 mm. high, h/d ratio 1.89–1.96, whorls 6 to 6¼.

4. A single adult from Krabin (USNM 363621), central Thailand, has a reddish columellar suffusion, the columellar bands replaced by a row of spots, a yellow subsutural band, and rather reddish brown radial blotches that do not reach the suture (pl. 1, fig. 6). It is 25.2 mm. high, h/d ratio 2.03 with 6¾ whorls.

5. A worn adult from Sriracha (USNM 405892), southeast Thailand, has the purplish-brown basal bands, and longer, more widely spaced radial streaks.

6. A juvenile shell from Nong Yang (USNM 384158a), southeast Thailand, has the color pattern, including reddish patch, of the type figures of *A. areolatus*. The only change from the type "5" is the angle of the radial streaks.

7. Specimens from Pak Jong (USNM 365464, USNM 405908), eastern Thailand, Hoi Yang (USNM 420291), near Sriracha, southeastern Thailand, and Tha Lo (USNM 419193), Peninsular Thailand, show minor variations of yet another color pattern. They have the reddish columellar patch, two basal bands (becoming obsolete on one Pak Jong juvenile), and reddish to purple radial markings of the above forms, but differ in possessing a peripheral spiral yellow band (pl. 1, fig. 7) that stands in sharp contrast to the whitish background between the radial streaks. The radial streaks may be narrow, wide, crowded, or widely spaced.

A worn shell from Koh Samet (USNM 384154a), an island in the Gulf of Siam, Southeast Thailand, could not be referred to any color variety.

***Amphidromus semitessellatus* (Morlet, 1884)**

PLATE 2 (FIGS. 2–6)

Bulimus (Amphidromus) semitessellatus Morlet, 1884, Journ. de Conch., vol. 32, pp. 287–288, pl. 11, figs. 2, 2a [Laos].

Amphidromus semitessellatus (Morlet).—Laidlaw and Solem, 1961, Fieldiana, Zool., vol. 41, no. 4, p. 564.

Specimens from Sam Roi Yot (USNM 420457, USNM 420458) and Nakon Sritamarat (USNM 419814) in Peninsular Thailand and Srakeo (USNM 419811), southeast Thailand, are tentatively grouped under this name. Size variation in the Sam Roi Yot specimens is summarized in table 1.

Color variation is considerable. The types had a subsutural black or purplish band and the upper spire a series of brownish spots. The body whorl was pale or with subperipheral spiral bands of purple or black. The Sam Roi Yot examples (pl. 2, figs. 3–6) show a wide range of patterning, with yellow, purple, or no subsutural bands, with spots or heavy streaks and sometimes with a yellow green periderm. Basal bands are present on one specimen. The single shell from Srakeo (pl. 2, fig. 2) has an even more modified pattern on the lower whorls with the streaks narrowed, reddish brown, short, and widely spaced. The specimens from Nakon Sritamarat (28.2 mm. high) and Srakeo (31.2 mm. high) are much smaller than the Sam Roi Yot specimens. A juvenile shell from Pran (USNM 419815), Peninsular Thailand, probably belongs to this species.

Amphidromus xiengensis Morlet, 1891

PLATE 2 (FIGS. 7–13)

Amphidromus xiengensis Morlet, 1891, Journ. de Conch., vol. 39, pp. 27, 232, 240–241, pl. 5, fig. 4 [Xieng Moi Plateau, Laos].—Laidlaw and Solem, 1961, Fieldiana, Zool., vol. 41, no. 4, pp. 564–565.

Five color forms could be distinguished in the material examined:

1. Form *xiengensis* (pl. 2, fig. 10) has the radial streaks interrupted by a single spiral yellow zone and has the streaking continued to (or near to) the aperture. A single adult (37.6 mm. high with 7 whorls) from Chiengmai (USNM 420267), North Thailand, is atypical only in having the radial streaking greatly reduced on the last part of the body whorl as in many examples of form *clausus*.

2. Form *multifasciatus* Fulton, 1896, has the radial streaks interrupted by several spiral yellow bands with the streaks continuing to the aperture. No adequately localized material of this variation was seen, although the specimen cataloged as USNM 522371, received from Fulton, is possibly a paratype.

3. From *clausus* Pilsbry, 1900, has the patterning obsolete at least on the last part of the body whorl, several spiral bands interrupting the radial flames, and a distinctive buff-yellow tone to the portion of the shell without radial pattern. Numerous specimens were seen from Chiengdao (USNM 419906, USNM 420330, USNM 420331, USNM 420333) and Doi Hua Mot (USNM 527275) at 1,000 meters elevation in North Thailand. Size variation is summarized in table 1. The umbilicus varies from narrowly to widely open. Of 20 adult shells from Chiengdao, 5 have most or all of the radial pattern reduced or absent, 4 have very little pattern reduced, and the remaining have one or two whorls without radial patterning (pl. 2, figs. 11–13).

4. Material from Kao Sabab at 300 (USNM 427324), 500 (USNM 427336), and 600 (USNM 427316) meters and Kao Bantad near Krat (USNM 405858a) in Southeast Thailand represent an unnamed color variation that differs in lacking the red subsutural band and in having the radial streaks broadened on the last whorl, which is usually darker in tone than the preceeding ones (pl. 2, figs. 7–8). It is thus the opposite of the *clausus* variation where the last whorl is much lighter than the preceding ones. Two of the thirteen specimens, however, are yellow with only a single reddish spiral band on the body whorl midway between the umbilicus and the periphery. The Kao Sabab shells are slightly smaller than those of the Chiengdao population (see table 1), and the population may be subspecifically distinct. Nomenclatural recognition would be premature, since so little material is available of this species.

5. Two shells from Kao Pae Nam, Lomsak (USNM 427295), Central Thailand, are doubtfully referred here. The slightly worn adult (pl. 2, fig. 9) has a reddish subsutural line, a red suffusion around the columella, no basal bands, broad wavy flames on the first half of the body whorl with the last half monochrome. On the upper whorls the radial streaks are bisected or trisected above the periphery, partially to completely fused below. The shell is slender (31.0 mm. high, h/d ratio 2.13, with 6⅞ whorls) and approached the *A. semitessellatus* and *A. xiengensis* variations in size and patterning. Its identity is uncertain.

Amphidromus fultoni Ancey, 1897

Amphidromus fultoni Ancey, 1897, Nautilus, vol. 11, pt. 6, pp. 62–63 [Cochin, China].—Laidlaw and Solem, 1961, Fieldiana, Zool., vol. 41, no. 4, p. 565.

A juvenile shell from Koh Prab near Bandon (USNM 361454), Peninsular Thailand, has the same color pattern shown in the type figures. More adequate collections may show that *fultoni* is only a color phase of another species.

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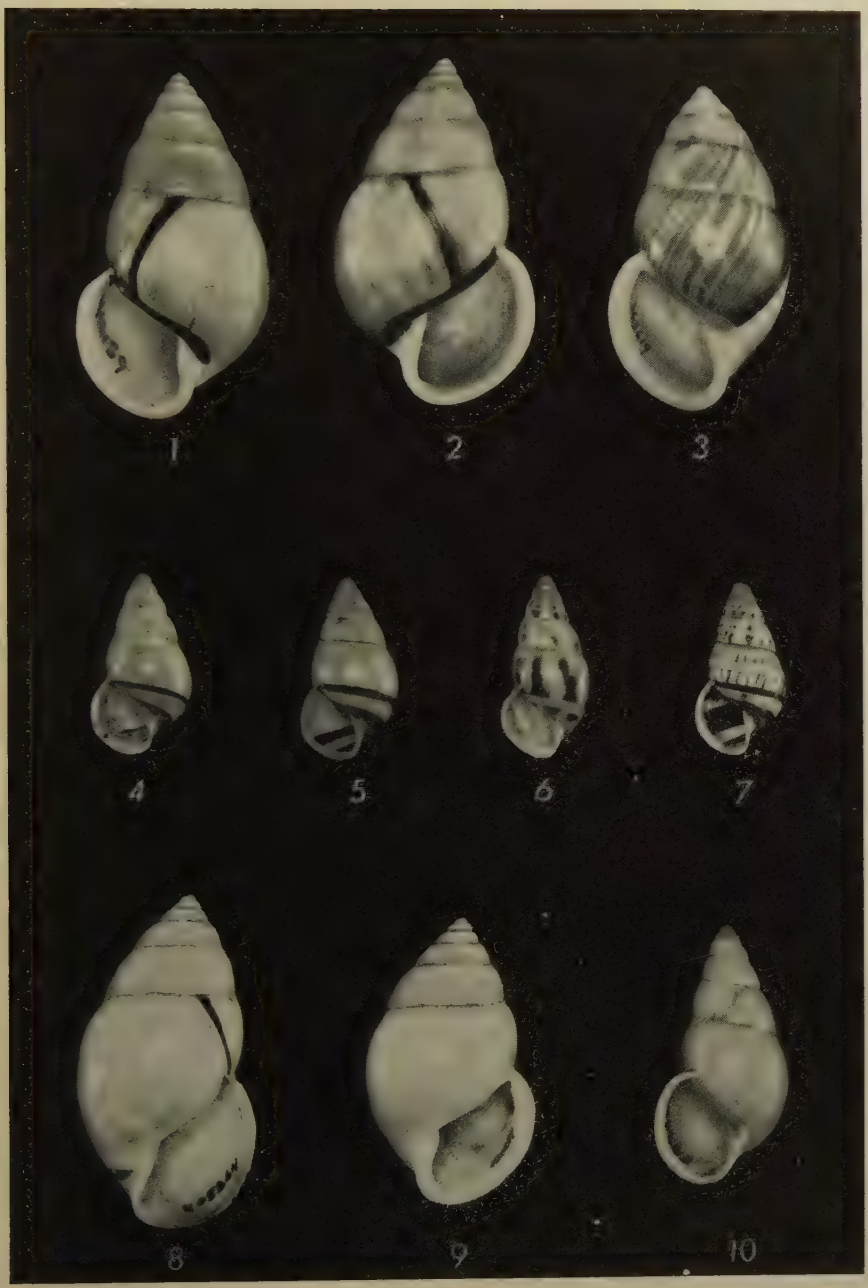
PLATE 1

FIGURES 1–10.—*Amphidromus atricallosus* (Gould): 1 (USNM 419189), typical form, from Kao Luang, west of Nakron Sritamarat, Peninsular Thailand; 2 (CNHM 109473), variant form with slight brownish suffusion, from Khao Luang, west of Prachuab Kirikhan, West Thailand; 3 (USNM 363619), form *laidlawi*, new form, holotype, from Nong Khor, Southeast Thailand. *Amphidromus areolatus* (Pfeiffer): 4 (USNM 427307), color form 1, from Kao Chong, Peninsular Thailand; 5 (USNM 361448), color form 2, from Tale Sap, Peninsular Thailand; 6 (USNM 363621), color form 4, from Krabin, Central Thailand; 7 (USNM 419193), color form 7, from Tha Lo, Peninsular Thailand. *Amphidromus atricallosus* (Gould): 8 (USNM 405864), form *leucoxanthus* von Martens, from Lem Sing, Chantabun, Eastern Thailand; 9 (USNM 420288), form *perakensis* Fulton, from Hoi Yang, near Sriracha, Southeast Thailand. *Amphidromus sinensis indistinctus* Pilsbry: 10 (USNM 405863), from Ban Nam Kien, North Thailand.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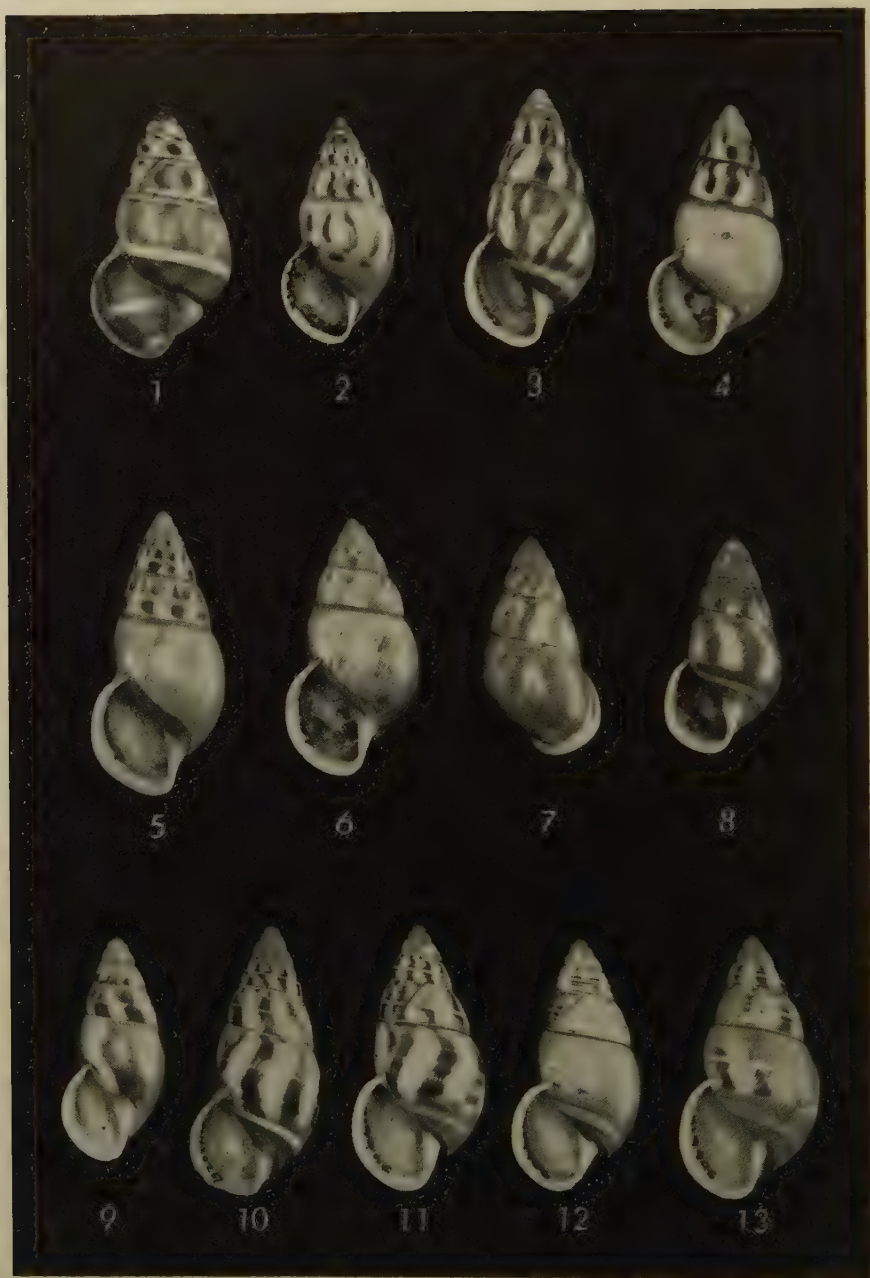
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PLATE 2

FIGURES 1–13.—*Amphidromus glaucolarynx* (Dohrn): 1 (USNM 427382), form *fasciatus* von Martens, from Wang Kien, Central Thailand. *Amphidromus semitessellatus* Morlet: 2 (USNM 419811), an unnamed color form showing reduction of the stripes, from Srakeo, Southeast Thailand; 3–4 (USNM 420458), color forms from Sam Roi Yot, Peninsular Thailand; 5–6 (USNM 420457), color forms from another set from Sam Roi Yot, Peninsular Thailand. *Amphidromus xiengensis* Morlet: 7–8 (USNM 427324), unnamed color form from 300 meters elevation at Kao Sabab, Southeast Thailand; 9 (USNM 427295), unnamed color form from Kao Pae Nam, Lomsak, Central Thailand; 10 (USNM 420267), typical color form, from Chiengmai, North Thailand; 11–13 (USNM 419906), form *clausus* Pilsbry, from Chiengdao, North Thailand, showing variation in reduction of the color pattern.